Attachment 2 to GNRO-2013/00088

JC -Q1B21-N678-1 Rev. 2 "Reactor Steam Dome Pressure Scram Setpoint"

☐ ANO-1 ☐ ANO-2 ☒ GGNS ☐ IP-2 ☐ IP-3 ☐ PLP
☐ JAF ☐ PNPS ☐ RBS ☐ VY ☐ W3
☐ NP-GGNS-3 ☐ NP-RBS-3

CALCULATION COVER PAGE	(1) **EC #** 39554	(2) **Page 1 of** 33

(3) Design Basis Calc. ☒ YES ☐ NO	(4) ☒ CALCULATION ☐ EC Markup
(5) **Calculation No:** JC-Q1B21-N678-1	(6) **Revision:** 002
(7) **Title:** Technical Specification Setpoint Determination for Reactor Dome Pressure Scram	(8) **Editorial** ☐ YES ☒ NO
(9) **System(s):** B21	(10) **Review Org (Department):** NPE (I&C Design)

(11) **Safety Class:**	(12) **Component/Equipment/Structure Type/Number:**	
☒ **Safety / Quality Related**	1B21N078A	1B21N678A
☐ **Augmented Quality Program**	1B21N078B	1B21N678B
☐ **Non-Safety Related**	1B21N078C	1B21N678C
(13) **Document Type:** J05.02	1B21N078D	1B21N678D
(14) **Keywords (Description/Topical Codes):** setpoint, uncertainty		

REVIEWS

(15) Name/Signature/Date	(16) Name/Signature/Date	(17) Name/Signature/Date
Mary Coffaro / MJ Coffaro 10/8/13	Robin Smith / 10/8/13	/
Responsible Engineer	☒ **Design Verifier** ☐ **Reviewer** ☒ Comments Attached	**Supervisor/Approval** ☐ Comments Attached

Revision	Record of Revision
0	Original issue.
1	Prepared in response to CR-GGN-2004-0038 & CR 2000-0100.
2	Extended calibration interval to 24 months, incorporated results of drift calculations JC-Q1111-09020. Updated transmitters' environmental zones and parameters per current revision of referenced documents. Revised trip unit calibration interval to 92 days to agree with Technical Specifications. Updated MTE, SE and bias terms to be consistent with current revision of JS09. Updated references and performed general maintenance. Added TSTF-493 Section 6.0.

CALCULATION REFERENCE SHEET	CALCULATION NO: JC-Q1B21-N678-1 REVISION: 002

I. EC Markups Incorporated **NONE**

II. Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
1. JS09	0	001	☒	☐		
2. E100.0	0	007	☒	☐		
3. 06-IC-1B21-Q-1002	--	101	☒	☐		
4. 06-IC-1B21-R-0001	--	105	☒	☐		
5. MS02	0	051	☒	☐		
6. ABD01	0	000	☒	☐		
7. J1281L	021A	000	☒	☐		
8. J1281L	021B	000	☒	☐		
9. J1281L	021C	000	☒	☐		
10. J1281L	021D	000	☒	☐		
11. M1077B	0	034	☒	☐		
12. 865E520	002	008	☒	☐		
13. 865E521	002	007	☒	☐		
14. 164C5150	001	018	☒	☐		
15. 164C5150	002	017	☒	☐		
16. 164C5150	003	018	☒	☐		
17. 184C4571	001	009	☒	☐		
18. J1507A	0	001	☒	☐		
19. J1507D	0	001	☒	☐		
20. 460000047	0	300	☒	☐		
21. J0400	0	018	☒	☐		
22. J0401	0	014	☒	☐		
23. CR-GGN-1999-01828	--	0	☒	☐		
24. JC-Q1111-09020	0	000	☒	☐		
25. A0552	0	018	☒	☐		
26. 368X543BA	0	044	☒	☐		
27. 368X559BA	0	039	☒	☐		
28. SDC-B21	0	003	☒	☐		
29. 22A4622	0	007	☒	☐		
30. 0200-047-0128	0	000	☒	☐		
31. A0014	0	009	☒	☐		
32. 17-S-06-5	--	010	☒	☐		
33. 22A3856AA	0	012	☒	☐		
34. 460000944	0	300	☒	☐		

II. Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
35. EAR-E90-0158	--	000	☒	☐		
36. A0012	0	015	☒	☐		
37. A0120	0	016	☒	☐		
38. J301.0-QS-27.0-15-0	--	0	☒	☐		
39. EC-Q1000-86001	0	003	☒	☐		
40. 460001972	0	300	☒	☐		
41. NEDC31336	--	0	☒	☐		
42. PERR91-6068	--	1	☒	☐		
43. 865E522	002	006	☒	☐		
44. 865E523	002	006	☒	☐		
45. J1507B	0	001	☒	☐		
46. J1507C	0	001	☒	☐		
47. 368X544BA	0	025	☒	☐		
48. 368X558BA	0	024	☒	☐		
49. GEXI2000-00134	--	0	☒	☐		
50.						

III. CROSS REFERENCES:

1. Technical Specification 3.4.12
2. Asset Suite Equipment Data Base (EDB)
3. "Handbook of Chemistry and Physics, 57th Edition, 1976-1977", published by the Chemical Rubber Co.
4. Tech. Spec./TRM Tables 3.3.1.1-1
5. UFSAR Section 15.2.1.2.2

IV. SOFTWARE USED:

Title: N/A Version/Release: Disk/CD No.

V. DISK/CDS INCLUDED:

Title: N/A Version/Release Disk/CD No.

VI. OTHER CHANGES:

Related references removed from the calculation: CR-GGN-2000-0100, 169C8394, EAR-E90-0158, CR-GGN-1999-01828 CA9, VMN 460000944

TABLE OF CONTENTS

1.0 PURPOSE AND DESCRIPTION

1.1. Purpose

The purpose of this calculation is to verify the allowable value and nominal trip setpoint for the Reactor Dome Pressure Scram in the Technical Specifications.

1.2. Setpoint Bases

1.2.1. Loop Descriptions

This loop consists of the instruments 1B21-PT-N078A/B/C/D and 1B21-PIS-N678A/B/C/D.

1.2.2. Design Bases

Pressure sensors are furnished which, in conjunction with the Reactor Protection System, scram the reactor if reactor pressure increases, encroaching on the required margin of safety established for safety/relief valve setpoints. (Ref. 2.2.22, 2.2.23, 2.2.27)

1.3. Design Bases Event(s)

1.3.1. The DBE for the high dome pressure scram setpoint is the closure of the MSIV's with pressure scram. The normal scram path associated with MSIV closure and High neuron flux are assumed to fail. (Ref. 2.2.45)

1.3.2. When the reactor is operating at less than full power, the high neutron flux scram may not be initiated. Under these conditions, the high dome pressure scram is credited. (Ref. 2.2.29)

1.3.3. Per Reference 2.2.39, the components in these loops are seismic category 1 instruments. Per Reference 2.1.1, seismic effects are not required to be considered for setpoint loops because the reactor will be shutdown following a seismic event. Therefore seismic effects will not be considered for the subject loops.

1.4. Analytical and Technical Specification Limits

Analytical Limit (PSIG)	Allowable Value (PSIG)	Nominal Trip Setpoint (PSIG)
1095.0	1079.7	1064.7

Ref. 2.2.1, 2.2.28, 2.2.33

2.0 REFERENCES

2.1. Relationships

2.1.1. JS09, Setpoint Methodology

2.1.2. Environmental Parameters Specification No. E100.0

2.1.3. Surveillance Procedure 06-IC-1B21-Q-1002

2.1.4. Surveillance Procedure 06-IC-1B21-R-0001

2.1.5. MS02

2.2. Cross References

2.2.1. ABD01

2.2.2. Setpoint Control Loop Diagram J1281L-021A

2.2.3. Setpoint Control Loop Diagram J1281L-021B

2.2.4. Setpoint Control Loop Diagram J1281L-021C

2.2.5. Setpoint Control Loop Diagram J1281L-021D

2.2.6. M1077B

2.2.7. 865E520-002

2.2.8. 865E521-002

2.2.9. PPD 164C5150-001, 164C5150-002, 164C5150-003

2.2.10. PPD 184C4571-001

2.2.11. J1507A

2.2.12. J1507D

2.2.13. Rosemount Instruction Manual 4247-1 (Vendor Man. Num. 460000047)

2.2.14. Location Dwg. J0400

2.2.15. Location Dwg. J0401

2.2.16. Not Used

2.2.17. JC-Q1111-09020, Drift Calculation for Rosemount Range Code 9 Gage Pressure Transmitters

2.2.18. GEXI2000-00134, Statistical Variation Associated With Published Performance Variable

2.2.19. Radiation Zones A0552

2.2.20. 368X543BA

2.2.21. 368X559BA

2.2.22. SDC-B21

2.2.23. 22A4622

2.2.24. Calculation 0200-047-0128

2.2.25. A0014

2.2.26. Not Used

2.2.27. 17-S-06-5

2.2.28. 22A3856AA

2.2.29. FSAR Section 15.2.1.2.2

2.2.30. Not Used

2.2.31. Not Used

2.2.32. Not Used

2.2.33. Tech. Spec./TRM Tables 3.3.1.1-1

2.2.34. Not Used

2.2.35. A0012

2.2.36. A0120

2.2.37. J301.0-QS-27.0-15-0, Result Of Low Radiation Dose Rate & LO Level LOCA Evaluation For Model 1153 Series B Rosemount Report D8600063 Revision A

2.2.38. EC-Q1000-86001

2.2.39. Asset Suite Equipment Data Base (EDB)

2.2.40. VMN 460001972

2.2.41. "Handbook of Chemistry and Physics, 57th Edition, 1976-1977", published by the Chemical Rubber Co.

2.2.42. Technical Specification 3.4.12

2.2.43. Not Used

2.2.44. Not Used

2.2.45. NEDC31336

2.2.46. PERR91-6068

2.2.47. Not Used

2.2.48. Not Used

2.2.49. 865E522-002

2.2.50. 865E523-002

2.2.51. J1507B

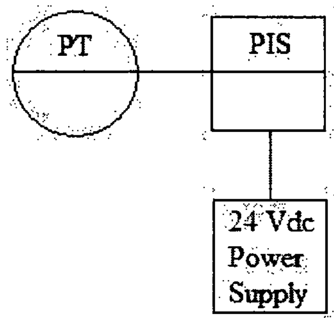
2.2.52. J1507C

2.2.53. 368X544BA

2.2.54. 368X558BA

3.0 GIVEN

3.1. Loop Block Diagram



PT:	1B21-PT-N078A/B/C/D	Ref. 2.2.2, 2.2.3, 2.2.4, 2.2.5
PIS:	1B21-PIS-N678A/B/C/D	Ref. 2.2.2, 2.2.3, 2.2.4, 2.2.5
PS:	1B21-JY-K613A/B/C/D	Ref. 2.2.2, 2.2.3, 2.2.4, 2.2.5

3.2. Primary Element

See Assumption 4.7

3.3. Instrument Tubing

See Assumption 4.7

3.4. Environmental Data

3.4.1. Transmitters

Instrument	Room	Panel	Reference
1B21-PT-N078A	Room 1A313	1H22-P004	2.2.2, 2.2.11, 2.2.35
1B21-PT-N078B	Room 1A311	1H22-P027	2.2.3, 2.2.12, 2.2.35
1B21-PT-N078C	Room 1A313	1H22-P005	2.2.4, 2.2.35, 2.2.52
1B21-PT-N078D	Room 1A311	1H22-P026	2.2.5, 2.2.35, 2.2.51

Description	Data	Reference
Environmental Conditions for Instruments 1B21-PT-N078A/C in room 1A313:		
Normal:	Zone N-068	2.1.2
Pressure	-1.0 to -0.10 in. wg.	
Expected Temperature	90°F	
Temperature Range	60°F to 105°F	
Humidity	20% to 90% R.H.	
Dose Rate	0.011 Rad/Hr.	
Radiation (Gamma) TID	3.1 X 10^3 Rads	

Accident*:	Zone A-016	2.1.2
Pressure	Curve Set 2	
Temperature	Curve Set 2	
Humidity	100% R.H.	
Radiation (Gamma) TID	5.6×10^6 Rads (Gamma)	
	2.84×10^8 Rads (Beta)	

*** See Assumption 4.4**

Seismic Conditions:	Not Required	Section 1.3.3

Description	Data	Reference

Environmental Conditions for Instruments 1B21-PT-N078B/D in room 1A311

Normal:	Zone N-069	2.1.2
Pressure	-1.0 to -0.10 in. wg.	
Expected Temperature	90°F	
Temperature Range	60°F to 105°F	
Humidity	20% to 90% R.H.	
Dose Rate	0.026 Rad/Hr.	
Radiation (Gamma) TID	6.3×10^3 Rads	
Accident*:	Zone A-016	2.1.2
Pressure	Curve Set 2	
Temperature	Curve Set 2	
Humidity	100% R.H.	
Radiation (Gamma) TID	5.6×10^6 Rads (Gamma)	
	2.84×10^8 Rads (Beta)	

*** See Assumption 4.4**

Seismic Conditions:	Not Required	Section 1.3.3

3.4.2. **Trip Units & Power Supplies**

Instrument	Room	Panel
1B21-PIS-N678A	0C703 (Ref. 2.2.2, 2.2.15, 2.2.25)	1H13-P691
1B21-PIS-N678B	0C504 (Ref. 2.2.3, 2.2.14, 2.2.36)	1H13-P692
1B21-PIS-N678C	0C703 (Ref. 2.2.4, 2.2.15, 2.2.25)	1H13-P693
1B21-PIS-N678D	0C504 (Ref. 2.2.5, 2.2.14, 2.2.36)	1H13-P694
1B21K613A	0C703 (Ref. 2.2.2, 2.2.15, 2.2.25)	1H13-P691
1B21K613B	0C504 (Ref. 2.2.3, 2.2.14, 2.2.36)	1H13-P692

1B21K613C	0C703 (Ref. 2.2.4, 2.2.15, 2.2.25)	1H13-P693
1B21K613D	0C504 (Ref. 2.2.5, 2.2.14, 2.2.36)	1H13-P694

Description	Data	Reference
Normal:	Zone N-028	2.1.2
Temperature	69-90°F	
Pressure	+0.1 to 1.0 in wg.	
Humidity	20% to 50% RH	
Radiation (Gamma) (see note below)	1.75E2 rads (40 yr TID)	

Note: Gamma Radiation Dose = $\frac{0.5\ m\ Rad}{hour}$ x $\frac{365.25\ days}{year}$ x $\frac{24\ hours}{day}$ x 40 $years$ = 1.75E2 Rads

Accident Environment: Rooms 0C504, 0C703	Same as Normal	Ref. 2.1.2
Seismic Conditions:	Not Required	Section 1.3.3

3.5. Vendor Data

3.5.1. Transmitter Data

Description	Data	Reference
Tag Number	1B21-PT-N078A,B,C,D	2.2.2, 2.2.3, 2.2.4, 2.2.5
Manufacturer:	Rosemount	2.2.20, 2.2.21
Model Number:	1153GD9PC	2.2.53, 2.2.54
Span	1500 PSIG / 4 to 20 mAdc	2.1.4, 2.2.39
Upper Range Limit (URL):	3000 PSIG	2.2.40
Calibrated Span	15 to 1515 PSIG / 4 to 20 mAdc	2.1.4, 2.2.39
Reference Accuracy:	± 0.25% span (3σ)	2.2.40, 2.2.18
Drift:	± 0.403% Span for 30 months	2.2.17
Power Supply:	<0.005% span per volt (3σ)	2.2.40, 2.2.18
Temperature Effect	± (0.75% URL + 0.5% Span)*ΔT/100°F (3σ)	2.2.40, 2.2.18
Humidity:	N/A (0% to 100% RH)	2.2.40
Radiation:	± 6.0% URL during and after Exposure to 5.19 x 10^7 Rads TID (γ)	2.2.40

Seismic Effect:	SE = ± 0.5% URL Seismic Effects (ZPA of 7 g's)	2.2.40
Static Pressure Effect	N/A for Gauge pressure device	2.2.40
Overpressure:	Overpressure effects are not applicable	4.13
Radiation Drift:	Radiation Drift effect is not applicable.	2.2.19, 2.2.38, 4.3

3.5.2. **Master Trip Unit Data**

Description	Data	Reference
Tag Numbers	1B21-PIS-N678A/B/C/D	2.2.2, 2.2.3, 2.2.4, 2.2.5
Manufacturer	Rosemount	2.2.7, 2.2.8, 2.2.9, 2.2.49, 2.2.50
Model	510 DU	2.2.7, 2.2.8, 2.2.9, 2.2.49, 2.2.50
	OR 710DUOTT	Assumption 4.12
Repeatability*:	± 0.20% span	2.2.13

* Repeatability based on Adverse Operating Condition and Normal Environment

Drift:	N/A	Assumption 4.11
Span	1500 PSIG	2.1.3, 2.2.9, 2.2.39

Humidity effects, power supply effects, temperature effects, and drift are included in the reference accuracy.

The trip units are located in a non harsh environment, therefore radiation and radiation drift effects are not applicable.

Static pressure effect and overpressure effect are not applicable to electronic instrumentation.

3.5.3. **Power Supplies**

Description	Data	Reference
Power Supply Tag Nos.	1B21K613A	2.2.2, 2.2.7
	1B21K613B	2.2.3, 2.2.8
	1B21K613C	2.2.4, 2.2.49
	1B21K613D	2.2.5, 2.2.50

Manufacturer	GE	2.2.7, 2.2.8, 2.2.10, 2.2.39, 2.2.49, 2.2.50
Model	184C4571P008	2.2.7, 2.2.8, 2.2.10, 2.2.39, 2.2.49, 2.2.50
Power Supply Nominal	24.0 volts	2.2.7, 2.2.8, 2.2.10, 2.2.39, 2.2.49, 2.2.50
Range * See Assumption 4.9	23.0 to 28.0 Vdc	2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.10

4.0 ASSUMPTIONS

4.1. All uncertainty values are assumed to be 2 sigma values unless specified otherwise.

4.2. The M&TE values are assumed to be less than or equal to the reference accuracy of the individual devices unless the actual M&TE values are greater, in which case the more conservative value will be used.

4.3. Because of the low dose rate associated with the normal environment for these locations (Total 40 Yr TID < 10^4), they are not considered "Harsh Conditions" and radiation drift will not be considered. (Ref. 2.2.38)

4.4. Environmental Uncertainties for the transmitters are assumed to be determined by normal environmental conditions. The transmitter is not required to act under accident (LOCA) conditions, since this condition would lead to depressurization of the Reactor Vessel and prevent loop trip actuation. Containment pressure and temperature are assumed to remain at their normal operating values until the trip occurs.

4.5. Not Used

4.6. Not Used

4.7. The over pressure analysis takes into account the pressure difference between the RPV bottom and the reactor steam dome pressure when establishing the high pressure scram setpoint. Therefore, no additional process measurement accuracy allowance is needed for the pressure difference between the RPV bottom and the steam dome. The process measurement accuracy allowance due to instrument line temperature is estimated to be less than one inch of water. Further, no primary element exists within the loop which could produce a primary element uncertainty; therefore no primary element uncertainty need be considered. (Ref. 2.2.45)

4.8. The transmitter is not required to function in LOCA accident conditions. Any exposure to an elevated temperature for a short period of time is assumed to produce a negligible insulation resistance (IR) change. In addition, any insulation resistance losses will produce a positive bias which will tend to reduce the calculated uncertainty. (Ref. 2.2.24) Therefore it is conservative to assume IR losses are negligible.

4.9. The loop power supply is a 24VDC safety related power supply. (Ref. 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.10). The power supply has a full load to no load variance of 23 VDC to 28 VDC. The power supply is assumed to supply a nominal voltage of 24 VDC. Therefore, the maximum voltage variance will occur from the nominal voltage setting condition to a no load condition. The voltage variance used in the calculation will be 4.5 volts. This allows for the 4 volt change from the nominal condition to the no load condition and a 0.5 volt nominal voltage uncertainty to account for voltage ripple effect.

4.10. Not Used

4.11. The accuracy of the Rosemount trip units (±0.20% span) is valid for six months (Ref. 2.2.13). A calibration interval of 92 days plus a 25% grace period (115 days) will be assumed for the trip units (Ref. 2.2.33). Therefore, drift is included in reference accuracy.

4.12. The model number of the trip unit is not specified on the PPD 164C5150 (Ref. 2.2.9). It is currently a 510DU2 (except for 1B21N678A which is identified in the EDB as a 710DU0TT) based on the EDB (Ref. 2.2.39) and PERR91-6068 (Ref. 2.2.46). However, this PERR authorized replacement of the obsolete 510DU2 with the 710DUOTT. The accuracy specifications of the 510DU can still be assumed after the replacement since the 710DU has better accuracy specifications.

4.13. Overpressure effects are not applicable because the maximum pressure that the transmitters are subjected to is a pressure of 1100 PSIG (Ref. 2.1.5, 2.2.6), which is below the URL of the transmitter (Ref. 2.2.40).

4.14. A 24 month refuel cycle will be assumed for the transmitters in this calculation. Applying +25% margin (per Reference 2.1.1) yields a calibration interval of 30 months.

4.15. **MTE** Per Reference 2.1.1, the M&TE error is normally considered equivalent to the reference accuracy of the trip unit. Per Reference 2.1.4, a Rosemount 710DU Readout Assembly (±0.01 mAdc, per Reference 2.2.13) is used to calibrate the Rosemount Trip Unit. The actual M&TE error (MTE_2) for the Rosemount Trip Unit is = ±0.01 mAdc, which is equivalent to ± 0.9375 PSIG

Output Range = 4 to 20 mAdc   Input Range = 0 to 1500 PSIG

$$\frac{1500\ PSIG}{16\ mAdc} = \frac{93.75\ PSIG}{mAdc} \qquad \frac{93.75\ PSIG}{mAdc} \times 0.01\ mAdc = 0.9375\ PSI$$

This value is less than the equivalent trip unit reference accuracy of ±0.20% Span = 3.0 PSIG

However, Per Reference 2.1.3 and 2.2.39, the trip unit is calibrated to ± 0.04 mAdc which is equivalent to:

$$\frac{1500\ PSIG}{16\ mAdc} = \frac{93.75\ PSIG}{mAdc} \qquad \frac{93.75\ PSIG}{mAdc} \times 0.04\ mAdc = 3.75\ PSI$$

This value is greater than the equivalent trip unit reference accuracy of ±0.20% Span = 3.00 PSIG and the more conservative of the three values will be used.

MTE for Trip Unit = 3.75 PSIG

Per Reference 2.1.4, a Heise pressure gauge (0-2000 PSIG) or equivalent (accuracy ± 3.75 PSIG) and a Fluke model 45 Digital Volt Meter (accuracy ± 0.04 mAdc) are used to calibrate the transmitter. The setting tolerance is specified as ± 0.04 mAdc.

DVM Accuracy: Output Range = 4 to 20 mAdc

Input Range = 15 to 1515 PSIG = 1500 PSIG

$$\frac{1500\ PSIG}{16\ mAdc} = \frac{93.75\ PSIG}{mAdc} \qquad \frac{93.75\ PSIG}{mAdc} \times 0.04\ mAdc = 3.75\ PSI$$

SRSS of M&TE Terms (MTE_1) for transmitter: MTE = $\{(3.75)^2 + (3.75)^2\}^{1/2}$ = 5.30 PSIG

This value is greater than the equivalent transmitter unit reference accuracy of ±(2/3)*0.25% Span = 2.50 PSIG and setting tolerance. The most conservative of the three values will be used.

MTE for Transmitter = 5.30 PSIG

5.0 CALCULATION

5.1. Definitions

5.1.1. Nomenclature

The nomenclature to be used in this calculation section will be explained.

5.1.2. Worst Case Calculation

A single calculation will be done for the worst case equipment in the worst case environment. The equipment and environment will be detailed.

5.1.3. Device Uncertainties

For each module, the uncertainty terms applicable to this application will be specified and combined into the following module errors:

RA – reference accuracy
L – negative bias uncertainty
M – positive bias uncertainty
MTE – measurement and test equipment inaccuracies
D – drift

5.1.4. Loop Uncertainties

The random and bias components of:

PE – errors associated with the Primary Element
PM – errors in Process Measurement, and
IR – errors due to degradation in Insulation Resistance

will be quantified, the loop error equation given, and the device and loop uncertainties combined to produce:

A_L – SRSS of all device random uncertainties except drift
L_L – The sum of all negative bias uncertainties
M_L – The sum of all positive bias uncertainties
C_L – SRSS of all measurement and test equipment inaccuracies used for calibration
D_L – SRSS of all drifts
LU – SRSS (A_L, C_L, PE, PM) + IR - L_L + M_L

5.1.5. Total Loop Uncertainty

The total loop uncertainty will be calculated using the Reference 2.1.1 equation:

$TLU = LU + D_L$

5.1.6. **Allowable Value**

The Allowable Value will be calculated using the Reference 2.1.1 equation:

AV = AL ± LU

5.1.7. **Nominal Trip Setpoint**

The nominal trip setpoint will be calculated using the Reference 2.1.1 equation:

NTSP = AL ± TLU

5.2. Device Uncertainties

5.2.1. **Transmitter Uncertainties**

Using the environmental and vendor data from Section 3.4 & 3.5:

URL = 3000 PSIG

SPAN= 1500 PSIG

RA_l = ± 0.25% span (3σ)
= ± (2/3)*(0.0025)*(1500 PSIG)
= ± 2.50 PSIG

Temperature Effect (Ref. Section 4.5, 4.6)

TE_l = ± (0.75% URL + 0.5% Span) * ΔT/100°F (3σ)
= ± (2/3)*[(0.0075*3000 PSIG) + (0.005*1500 PSIG)]* (15°F/100°F)
= ± 3.00 PSIG

Where ΔT is the maximum temperature variation during normal conditions.

The temperature variation is based on the maximum containment temperature above the normal value. For this case the maximum temperature variation is 15°F (105°F – 90°F). Therefore ΔT is 15°F. The temperature variation assumed during calibration (90°F – 65°F) will be included as a temperature drift. (Ref. 2.1.1)

Temperature Drift

TD_l = ± (0.75% URL + 0.5% Span)* ΔT/100°F (3σ)
= ± (2/3)*[(0.0075*3000 PSIG) + (0.005*1500 PSIG)]* (25°F/100°F)
= ± 5.00 PSIG

Where ΔT is the maximum temperature variation assumed during calibration. For this case the maximum temperature variation is 25°F (90°F – 65°F). (Ref. 2.1.1) Therefore ΔT is 25°F.

Humidity (HE) has no effect on the sealed transmitter.

HE_l = ± **0.000 PSIG** 2.2.40

Radiation Effect

RE_l = ± 6.0% URL during and after Exposure to 5.19 x 10^7 Rads TID (γ) 2.2.40

Since this transmitter is not expected to perform under accident conditions, radiation effects are not applicable.

RE_l = ± **0.000 PSIG**

Seismic Effect Section 1.3.3

SE_l = ± **0.000 PSIG**

Per Sections 3.5.3 & 4.9, the worst power supply variations are 4.5 volts.

PS_l = ± 0.005% span / volt variation (3σ)
= ± (2/3)*(0.00005)*(1500 PSIG)*(4.5 volts)
= ± **0.225 PSIG**

Over-Pressure Effects (OVP) refer to those uncertainties that may occur when pressure transmitters see pressures beyond their upper range limit prior to performing their required function. Overpressure effects are not applicable per Section 4.13

OVP_l = ± **0.0000 PSIA**

SPE_l = ± **0.000 PSIG**

DR_l = ± 0.403% Span for 30 months
= ± 0.403% * 1500 PSIG
= ± **6.045 PSIG**

Radiation Drift (RD): (Ref. 2.1.2, 2.2.19, 4.3)

RD_l = ± 0.000 psig

Summarizing for the transmitter:

A_l = ± SRSS (RA_l, TE_l, HE_l, RE_l, SE_l, PS_l, OVP_l, SPE_l)
= ± SRSS (2.50, 3.00, 0.00, 0.00, 0.00, 0.225, 0.00, 0.00)
= ± **3.92 PSIG**

L_l = **– 0.000 PSIG**
M_l = **+ 0.000 PSIG**

MTE_l = ± **5.30 PSIG** (Ref. section 4.15)

D_1 = ± SRSS (DR_1, TD_1, RD_1)
= ± SRSS (6.045, 5.00, 0.0000)
= **± 7.85 PSIG**

5.2.2. **Trip Unit Uncertainties**

Using the vendor data from Section 3.5.2:

SPAN = 1500 PSIG

A_2 = RA_2 = ± 0.20% span
= ± (0.0020)*(1500 PSIG)
= ± 3.00 PSIG

L_2 = **– 0.000 PSIG**
M_2 = **+ 0.000 PSIG**

MTE_2 = **± 3.75 PSIG** Assumption 4.15

D_2 = **± 0.00 PSIG** Assumption 4.11

5.3. **Loop Uncertainties**

5.3.1. **Primary Element Accuracy (PE)**

PE = ± 0.000 PSIA Assumption 4.7

5.3.2. **Process Measurement Accuracy (PM)**

PM = ± 0.000 PSIA Assumption 4.7

5.3.3. **Insulation resistance Effects (IR)**

IR = ± 0.000 inHg Assumption 4.8

5.3.4. **Using the equations from Reference 2.1.1 and the values from Section 5.2:**

A_L = ± SRSS (A_1, A_2)
= ± SRSS (3.92, 3.00)
= **± 4.94 PSIG**

L_L = $- L_1 - L_2$ = 0.0 psig
M_L = $+ M_1 + M_2$ = 0.0 psig

C_L = ± SRSS (MTE_1, MTE_2)
= ± SRSS (5.30, 3.75)
= **± 6.49 PSIG**

D_L = ± SRSS (D_1, D_2)
= ± SRSS (7.85, 0.00)
= ± **7.85 PSIG**

LU = ± SRSS (A_L, C_L, PM, PE)
= ± SRSS (4.94, 6.49, 0, 0)
= ± **8.16 PSIG**

5.4. **Total Loop Uncertainty**

TLU = ± (LU + D_L)
= ± 8.16 + 7.85
= ± **16.01 PSIG**

5.5. **Nominal Trip Setpoint**

5.5.1. **TS Setpoint**

The Analytical Limit for this calculation is 1095 PSIG. (Ref. 2.2.1, 2.2.28)

NTSP = AL – TLU

AL = 1095 psig

1095 PSIG – 16.01 PSIG = 1078.99 PSIG

Calculated Setpoint = 1079.0 PSIG

TRM Setpoint ≤ 1064.7 PSIG (Ref. 2.2.33)
Plant Setpoint = 1064.7 PSIG (Ref. 2.1.3)

Therefore, the TRM and Plant setpoints are conservative.

5.6. **Allowable Value (AV)**

Allowable Value = AL – LU
= 1095 PSIG – 8.16 PSIG
AV = 1086.84 PSIG

Calculated Allowable Value = 1086.9 PSIG

Technical Specification Allowable Value ≤ 1079.7 PSIG (Ref. 2.2.33)

Therefore, the Technical Specification Allowable Value is conservative.

5.7. **Spurious Trip Avoidance**

For Spurious Trip Avoidance purposes, the Limiting Operating Transient Variation must be calculated at the highest vessel pressure seen during operation since this value would tend to move the process closer to the trip setpoint.

Highest vessel pressure seen during normal operation = 1040 PSIG (Ref. 2.2.1)

$$Z = \frac{|NTSP - X_T|}{\frac{1}{N}\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}}$$

X_T = Limiting Operating Transient Variation

$X_T = X_0 + T + T_C$

Where:

X_0 = Maximum or Minimum Steady State Operating Value
= Normal operating pressure = 1040 PSIG (Ref. 2.2.1)

T = Magnitude of Limiting Transient Variation
= 5 PSIG (Ref. 2.2.41)

T_C = Modeling or Bias Uncertainty
= 30 PSIG (Ref. 2.2.45)

$X_T = X_0 + T + T_C$
= 1040 + 5 + 30
= 1075 PSIG

$$Z = \frac{|1064.7 - 1075|}{(1/2)*(4.94^2 + 6.49^2 + 7.85^2)^{1/2}}$$

Z = 1.81

This value meets the minimum Spurious Trip Avoidance criteria of 95% probability, Z ≥ 1.645; therefore, Spurious Trip Avoidance is verified.

5.8. **LER Avoidance** (Ref. 2.1.1, App. A)

From section 1.4, the Tech Spec allowable value = 1079.7 PSIG

$$Z = \frac{|AV - NTSP|}{\frac{1}{N}\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}}$$

$$Z = \frac{|1079.7 - 1064.7|}{(1/2)*(4.94^2 + 6.49^2 + 7.85^2)^{1/2}}$$

Z = 2.65

This setpoint exceeds the minimum LER avoidance criteria of 90% probability, $Z \geq 1.282$; therefore, LER avoidance is verified.

6.0 TSTF CALCULATIONS (Ref. 2.1.1)

6.1. As-Left Tolerance

ALT_1 – Transmitter TSTF-493 Calculation

$ALT_1 = RA_1$
$= \pm 2.50$ psig

Converting to loop current:

$ALT_1 = \pm$ (2.50 psig/1500 psig) * 16 mA
$= \pm$ 0.026 mA

ALT_2 – Trip Unit TSTF-493 Calculation

$ALT_2 = RA_2$
$= \pm$ 3.00 psig

Converting to loop current:

$ALT_2 = \pm$ (3.00 psig/1500 psig) * 16 mA
$= \pm$ 0.03 mA

6.2. As-Found Tolerance (AFT)

AFT_1 – Transmitter TSTF-493 Calculation

The drift value used in this calculation to determine transmitter drift was derived by statistical analysis, therefore per Reference 3.1.1:

$AFT_1 = \pm DR_1$

$DR_1 = \pm$ 6.045 psig for 30 months
$AFT_1 = \pm$ 6.045 psig

Converting to loop current:

$AFT_1 = \pm$ (6.045 psig/1500 psig) * 16 mA
$= \pm$ 0.06 mA

AFT_2 – Trip Unit TSTF-493 Calculation

$AFT_2 = \pm SRSS(RA_2, MTE_2, DR_2)$ Reference 3.1.1

AFT_2 = ± SRSS(3.00, 0.9375, 0)
= ± 3.14 psig

Converting to loop current:

AFT_2 = ± (3.14 psig/1500 psig) * 16 mA
= ± 0.03 mA

6.3. Loop Tolerances

ALT_L – As-Left Loop Tolerance

ALT_L = ± SRSS (ALT_1, ALT_2)
= ± SRSS (2.50, 3.00)
= ± 3.90 psig

Converting to loop current:

ALT_L = ± (3.90 psig/1500 psig) * 16 mA
= ± 0.04 mA

AFT_L – As- Found Loop Tolerance

AFT_L = ± SRSS (AFT_1, AFT_2)
= ± SRSS (6.045, 3.14)
= ± 6.81 psig

Converting to loop current:

AFT_L = ± (6.81 psig/1500 psig) * 16 mA
= ± 0.07 mA

7.0 CONCLUSION

The Plant Setpoint and Technical Specification Allowable Value are conservative.

SUMMARY OF RESULTS	
SYSTEM	B21
LOOP NUMBER	N678
TOTAL LOOP UNCERTAINTY	± 16.01 PSIG
LOOP UNCERTAINTY	± 8.16 PSIG
DRIFT ALLOWANCE	± 7.85 PSIG
M&TE ALLOWANCE	± 6.49 PSIG

	SPECIFIED VALUE	CALCULATION
ANALYTICAL LIMIT	1095 PSIG	-----------
ALLOWABLE VALUE	1079.7 PSIG	1086.9 PSIG
TRIP SETPOINT	1064.7 PSIG	1079.0 PSIG
TRM SETPOINT	1064.7 PSIG	1079.0 PSIG

SUMMARY OF CALIBRATION TOLERANCES	
As-Left Transmitter TSTF-493 (ALT_1)	±2.50 psig, ±0.026 mA
As-Left Trip Unit TSTF-493 (ALT_2)	±3.00 psig, ±0.03 mA
As-Found Transmitter TSTF-493 (AFT_1)	±6.045 psig, ±0.06 mA
As-Found Trip Unit TSTF-493 (AFT_2)	±3.14 psig, ±0.03 mA
As-Left Loop Tolerance (ALT_L)	±3.90 psig, ±0.04 mA
As-Found Loop Tolerance (AFT_L)	±6.81 psig, ±0.07 mA

Sheet 1 of 1

DESIGN VERIFICATION COVER PAGE

☐ ANO-1 ☐ ANO-2 ☐ IP-2 ☐ IP-3 ☐ JAF ☐ PLP
☐ PNPS ☐ VY ☒ GGNS ☐ RBS ☐ W3 ☐ NP

Document No. JC-Q1B21-N678-1	Revision No. 2	Page 1 of 4

Title: Technical Specification Setpoint Determination for Reactor Dome Pressure Scram

☒ Quality Related ☐ Augmented Quality Related

DV Method: ☒ Design Review ☐ Alternate Calculation ☐ Qualification Testing

VERIFICATION REQUIRED	DISCIPLINE	VERIFICATION COMPLETE AND COMMENTS RESOLVED (DV print, sign, and date)
☐	Electrical	
☐	Mechanical	
☒	Instrument and Control	Robin Smith [signature] 10/8/13
☐	Civil/Structural	
☐	Nuclear	
☐		
☐		

Originator:	Mary Coffaro / MG Coffaro 10/8/13 Print/Sign/Date After Comments Have Been Resolved

ATTACHMENT 9.6 **DESIGN VERIFICATION CHECKLIST**

Sheet 1 of 3

IDENTIFICATION:				DISCIPLINE:
Document Title: Technical Specification Setpoint Determination for Reactor Dome Pressure Scram				☐Civil/Structural ☐Electrical
Doc. No.: JC-Q1B21-N678-1	Rev. 2	QA Cat. 1		☒I & C
Verifier:	Robin Smith Print	[signature] Sign	10/8/13 Date	☐Mechanical ☐Nuclear ☐Other
Manager authorization for supervisor performing Verification. ☒ N/A	Print	Sign	Date	

METHOD OF VERIFICATION:		
Design Review ☒	Alternate Calculations ☐	Qualification Test ☐

The following basic questions are addressed as applicable, during the performance of any design verification. [ANSI N45.2.11 – 1974] [NP QAPD, Part II, Section 3][NP NQA-1-1994, Part I, BR 3, Supplement 3S-1].

NOTE The reviewer can use the "Comments/Continuation sheet" at the end for entering any comment/resolution along with the appropriate question number. Additional items with new question numbers can also be entered.

1. Design Inputs – Were the inputs correctly selected and incorporated into the design?

   (Design inputs include design bases, plant operational conditions, performance requirements, regulatory requirements and commitments, codes, standards, field data, etc. All information used as design inputs should have been reviewed and approved by the responsible design organization, as applicable.

   All inputs need to be retrievable or excerpts of documents used should be attached.

   See site specific design input procedures for guidance in identifying inputs.)

   Yes ☒ No ☐ N/A ☐

2. Assumptions – Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are assumptions identified for subsequent re-verification when the detailed activities are completed? *Are the latest applicable revisions of design documents utilized?*

   Yes ☒ No ☐ N/A ☐

3. Quality Assurance – Are the appropriate quality and quality assurance requirements specified?

   Yes ☒ No ☐ N/A ☐

4. Codes, Standards and Regulatory Requirements – Are the applicable codes, standards and regulatory requirements, including issue and addenda properly identified and are their requirements for design met?
Yes ☒ No ☐ N/A ☐

5. Construction and Operating Experience – Have applicable construction and operating experience been considered?
Yes ☒ No ☐ N/A ☐

6. Interfaces – Have the design interface requirements been satisfied and documented?
Yes ☒ No ☐ N/A ☐

7. Methods – Was an appropriate design or analytical (for calculations) method used?
Yes ☒ No ☐ N/A ☐

8. Design Outputs – Is the output reasonable compared to the inputs?
Yes ☒ No ☐ N/A ☐

9. Parts, Equipment and Processes – Are the specified parts, equipment, and processes suitable for the required application?
Yes ☐ No ☐ N/A ☒

10. Materials Compatibility – Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
Yes ☐ No ☐ N/A ☒

11. Maintenance requirements – Have adequate maintenance features and requirements been specified?
Yes ☒ No ☐ N/A ☐

12. Accessibility for Maintenance – Are accessibility and other design provisions adequate for performance of needed maintenance and repair?
Yes ☐ No ☐ N/A ☒

13. Accessibility for In-service Inspection – Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
Yes ☐ No ☐ N/A ☒

14. Radiation Exposure – Has the design properly considered radiation exposure to the public and plant personnel?
Yes ☐ No ☐ N/A ☒

15. Acceptance Criteria – Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?
Yes ☐ No ☐ N/A ☒

16. Test Requirements – Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
Yes ☒ No ☐ N/A ☐

17. Handling, Storage, Cleaning and Shipping – Are adequate handling, storage, cleaning and shipping requirements specified?
Yes ☐ No ☐ N/A ☒

18. Identification Requirements – Are adequate identification requirements specified?
Yes ☐ No ☐ N/A ☒

19. Records and Documentation – Are requirements for record preparation, review, approval, retention, etc., adequately specified? Are all documents prepared in a clear legible manner suitable for microfilming and/or other documentation storage method? Have all impacted documents been identified for update as necessary?
Yes ☒ No ☐ N/A ☐

20. Software Quality Assurance- ENN sites: For a calculation that utilized software applications (e.g., GOTHIC, SYMCORD), was it properly verified and validated in accordance with EN- IT-104 or previous site SQA Program? ENS sites: This is an EN-IT-104 task. However, per ENS-DC-126, for exempt software, was it verified in the calculation?
Yes ☐ No ☐ N/A ☒

21. Has adverse impact on peripheral components and systems, outside the boundary of the document being verified, been considered?
Yes ☒ No ☐ N/A ☐

Comments / Continuation Sheet

Question #	Comments	Resolution	Initial/Date
1	Comments provided by markup	Comments incorporated.	

Entergy

ATTACHMENT 9.10 ENGINEERING CHANGE COMMENT FORM
SHEET 1 OF 1

Page 1 of 1

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
Owner's Review Comments to JC-Q1B21-N678-1 (EC 18458)						
General Issues						
1	D. Hollis	DE-E	No comments	8/15/12	None required	N/A